the Acid Deposition Research Program

Members Committee
SUMMARY REPORT TO CRITICAL POINT 1

May, 1989

THE ACID DEPOSITION RESEARCH PROGRAM

MEMBERS COMMITTEE REPORT
"CRITICAL POINT ONE"

CALGARY, ALBERTA, CANADA
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Acid Deposition Research Program

MEMBERS COMMITTEE

Ken R. Smith
Co-Chairman
Alberta Environment

Ron L. Findlay
Co-Chairman
Canadian Petroleum Assoc.

Ed. R. Brushett
Energy Resources Conservation Board

Dr. John Railton
Utilities Group Representative

1500, 633 Sixth Avenue S.W., Calgary, Alberta T2P 2Y5 Telephone (403) 269-6721

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I. OVERVIEW

In December of 1984, Mr. Ken Smith on behalf of Alberta Environment, and Mr. Ron Findlay on behalf of the Canadian Petroleum Association, signed a formal agreement which brought into being the Acid Deposition Research Program. This formal signing brought to a close well over 12 years of work by both industry and government in Alberta to carry out research on the effects of acidifying compounds in the environment, and initiated the largest joint government-industry environmental research program on acidifying pollutants in Canada. The ADRP received a formal Charter signed by all participants and in so doing became registered as a distinct research entity in the province.

In the four years since its inception, the ADRP program completed three major studies:

- A $5.3 million Biophysical Research Study of the regional effects of acidifying compounds on the Alberta environment,

- A $3.8 million Medical Diagnostic Review, study of human health in the Pincher Creek area of Alberta, which was funded by Alberta Community and Occupational Health, and

- A $25 000 Feasibility Assessment for an Occupational Health Study in connection with occupational exposure of sweet gas, sour gas and the thermal plant on workers in the province.

The highlights of the three-phased program are summarized below:

- The 42-month Biophysical Research Study component of the program was carried out by a team of more than 50 researchers in 20 different disciplines from both the university and private sectors. The program was led by the University of Calgary's Kananaskis Centre for Environmental Research.

- The MDR Study, a community health assessment project, was carried out by more than 100 medical, technical and support personnel led by the Montreal Epidemiology Center in conjunction with McGill University of Montreal. Medical scientists conducted comprehensive and exhaustive medical health tests on more than 3 600 residents of southern Alberta in the study area and in two comparison communities.

- The Occupational Health Feasibility Assessment led by Dr. T. Guidotti of the Faculty of Medicine, University of Alberta, Edmonton examined the Alberta occupational health data base and made recommendations on the scope and nature of health research necessary to more fully assess occupational health risks from acid gas emissions to industrial workers. These recommendations are presently being examined by government and industry medical scientists.

Here, we review the objectives for all these major studies which were carried out under the aegis of the Acid Deposition Research Program.

II. HISTORY

A. The Beginnings

The impetus to the research programs undertaken by the ADRP was derived from a long history of public, governmental and industry concern about acid gas emissions in Alberta. Here we report in detail on the results from the Biophysical Research Program of the ADRP but also discuss more generally the results of the Medical Diagnostic Review and Occupational Health Studies carried out by ADRP since 1984.

The 1982 Lodgepole sour gas release in northwestern Alberta brought to a head more than 25 years of emotional controversy of the environmental and health effects of sour gas in southwestern Alberta and in other areas of the province. A major drawback to the controversy that occurred at that time, was that no one had reliable and comprehensive data on the effects of sour gas emissions on Alberta's environment or on the health of local residents or affected workers.

In 1972, industry and provincial government representatives founded the Alberta Petroleum Industry/Government Environment Committee (APIGEC), which was derived from the earlier Alberta Industry/ Government Sour Gas Committee. In 1973, an industry-funded study, the "Whitecourt Environmental Study Group" was formed to research the effects of sour gas on the surrounding forest areas. In 1979, an APIGEC sour gas workshop, sponsored by the participants, recommended that the Canadian Petroleum Association (CPA) and the Alberta Government establish a Steering Committee on Acid Gases in the Environment (SCAGE). This Steering Committee carefully, and more closely, examined the possible effects of sulphur dioxide on human health and the environment. A major recommendation arising from SCAGE called for the formation of the Acid Deposition Research Program (ADRP).

B. The Project Objectives

In the earliest stages of the ADRP, a top-caliber team of internationally-recognized scientists was invited to a dual-task workshop to help establish the objectives and work plans for the Program. The key objective of the workshops was to develop an integrated, multi-disciplinary approach to the study, in both its aspects of biophysical and human health research. The Biophysical Workshop was held in October 1983 and the Human Health Workshop in January 1984. In addition, a Communications Workshop was held in April 1984 in order to lay the foundation for public involvement and communications with Albertans.

In June 1984, ADRP released its first publication "Researching Acid Deposition: Workshop Proposals", a detailed compilation of the findings, conclusions and recommendations of the three workshops. In addition to publishing these detailed recommendations, the ADRP called for public responses and input to the scientists and managers then associated with the design of the ADRP. The public

responded to these requests, and numerous written responses were received, studied and in many instances adopted by the scientists in the program. Acknowledgements were mailed by the ADRP to each writer.

The scientific teams, who formulated the recommendations for the workshops, went on to be invited by the Members Committee to participate in the establishment of the Biophysical and Human Health Science Advisory Boards. These Boards served to maintain impeccable scientific advice throughout the Program and maintained continuity from the earliest beginnings through to the conclusion of the program.

In the Biophysical Program, it was decided to fund research to reach "Critical Point One". In July 1984, competitive tenders were called for from University and private-sector firms to act as prime contractor for the ADRP. In August, two major proposals were received and exhaustively reviewed by the Members Committee. In late December, 1984 the Kananaskis Centre for Environmental Research (KCER) submitted, on request, a detailed, revised Final Work Plan and Budget to Critical Point I. In early 1985, the Members Committee formally voted to accept the KCER consortium as the prime contractor. The scientific consortium was made up of more than 50 scientific and technical investigators led by Principal Investigator Dr. A. H. Legge. In addition, staff support for the program, by way of a Program Manager and Communications Co-ordinator, was retained by the Members Committee.

The KCER Study Team moved quickly, and by April, 1985 had submitted an exhaustive and peer-reviewed study to the Members Committee entitled: "Criteria and Recommendations for Point Source and Background Location Selection." This report allowed for the selection and approval of Fortress Mountain and Crossfield, Alberta as the background and downwind monitoring sites for the ADRP, respectively. These proposed sites, and the continuous air monitoring equipment to be located at them, would monitor sensitive and impacted environs for oxides of sulphur and oxides of nitrogen in Alberta's environment. Within just 6 months, the comprehensive biophysical monitoring stations were established. The masses of equipment needed to build these stations was obtained and the sites were all fully operational by August, 1985. After 24 months of continuous monitoring, the technical and communications requirements for Critical Point One were achieved and the final biophysical report was released.

During these same years, the $3.7 million Medical Diagnostic Review study led by the Montreal Epidemiology Center was managed by the ADRP on behalf of the Alberta Department of Community and Occupational Health. A further Occupational Health Feasibility Assessment was also completed by ADRP through a contract to the University of Alberta, Faculty of Medicine.

These programs of the ADRP are more fully discussed below.

III. THE MEDICAL DIAGNOSTIC REVIEW (MDR)

On June 11, 1986 in Pincher Creek, Alberta, the ADRP released the results of the MDR Program which had been carried out over a period of almost 12 months preceding the release.

The $3.8 million southwest Alberta Medical Diagnostic Review (MDR) was funded entirely by the Alberta Department of Community and Occupational Health, and administered by the Acid Deposition Research Program on behalf of that department. The research was led by the Montreal Epidemiology Center in association with McGill University after successful response to competitive tenders, under the direction of Dr. W. O. Spitzer, Principal Investigator.

The MDR set out to answer whether the residents of southwestern Alberta who lived in the vicinity of sour gas plants in the "Index Area" near Pincher Creek, Alberta had a different health status, or health experience, than comparable persons living in unexposed areas within the Province not in the vicinity of such facilities.

After exhaustive research to establish comparable demographic and community groups, the researchers defined a central Index Area near Pincher Creek. They subsequently established areas near Raymond/Stirling and near Crossfield as comparison communities for this major health study. Comparisons with samples of the exposed comparison community in the Didsbury/Carstairs/Crossfield/Irricana (DCCI) north of Calgary, and of the unexposed community of Raymond/Stirling assisted the investigators in the interpretation of contrasts between these populations. The physicians also made comparisons with other samples of Canadian populations.

The MDR study was not designed to explore cause or effect relationships of sour gas emissions in the study populations. It had as its main research question to determine whether there existed a possible "epidemic" of adverse health among people in the designated "Index Area". Long-standing, and serious concerns of health had been held by some of the residents of the Index Area and this study, first examined and approved by the Science Advisory Board to the MDR, was specifically designed to answer those concerns.

The Principal Investigator for the MDR was Dr. Walter Spitzer, President of the Montreal Epidemiology Center. He headed the McGill Inter-University Research Group, a Canadian team of scientists and physicians which was both outstanding and well-experienced in the field of epidemiology.

Dr. Spitzer worked with the Program to establish Community Advisory Boards made up of local residents in both the Index Area and comparison communities. These citizens proved vital to the effective implementation and execution of the MDR. He also closely co-operated with the Science Advisory Board (SAB) headed by Dr. Ben Burrows, Director, Division of Respiratory Sciences, University of Arizona. The other five SAB members, also outstanding physicians and medical scientists, had been appointed previous to awarding of

the MDR project and had been fundamental to the initial formulation of the Terms of Reference for the MDR Study. This international and world-class team of medical scientists for the SAB ensured that the research undertaken in the area was of the highest caliber. In addition, the Faculty of Medicine at McGill University established it's own Scientific Advisory Board to act as a "second check" on the study and to provide advice directly to the Dean of Medicine on its findings.

Approximately 100 medical, technical and other scientific support personnel participated in the examination of more than 3 600 adults and children in a four-Hour series of health examinations carried out in special units designed for field examinations. Included were two medical examinations, personal health questionnaires, the analysis of blood, urine and hair samples along with electrocardiograms and spirometry tests. Questionnaires were also sent to more than 2 000 people who lived in, but had since moved out of, the study area. The researchers also examined more than 25 years of health records in the three study areas in an effort to detect any evidence of health effects. In addition, the team completed a cancer study and a reproduction and birth defect study.

Throughout the study, the McGill research team actively consulted and worked with the Community Advisory Boards in all three areas.

The work of the ADRP Communications Program during the time of the MDR Study is too extensive to review in this overview document. Suffice to say that hundreds of interactions with the media as well as extensive related communications and other public involvement activities were carried out in order to publicize both the scientific work under the direction of the MDR team at that time and the results of the final study.

The study, when completed, constituted one of the largest clinical and environmental epidemiology (population health studies) ever conducted in Canada. Dr. Spitzer, also Chairman of the Epidemiology and Biostatistics Department at McGill University in Montreal, noted that the investigators took exhaustive measures to ensure the scientific credibility of their work. This involved several of the most exhaustive scientific scrutinies of the research and analysis by the SAB. These reviews strengthened the conclusions of the final report, which was authored and supported by some of the top epidemiologists, environmental scientists, chemists, toxicologists and clinical investigators from around the world. In June of 1986, Dr. Spitzer travelled to those southwestern Alberta communities, in which the Medical Diagnostic study had been carried out, to report on the results from his study team. At the well-attended community meetings, Dr. Spitzer noted that:

> "The greatest concerns of the population in the Index Area were about excess mortality, high rates of cancer, diminished respiratory function, dangerous levels of trace metals in the body, higher rates of unfavourable reproductive outcomes and birth defects, and delayed or abnormal childhood development.

> For all of the foregoing concerns, we have not detected objective evidence to perpetuate the concerns. We are confident of the scientific basis of that reassurance."

The scientists went on to make other numerous, and more scientific, recommendations and findings, all of which were detailed in a comprehensive report which was released to the public in June, 1986.

In response to a specific recommendation from the SAB for "limited additional analyses of data" regarding Selenium data obtained in the MDR, a sub-study to the MDR was commissioned by the Members Committee in 1988. This supplementary analysis by Dr. Spitzer and his team set out to re-analyze some of the clinical findings on selenium levels in hair and blood samples obtained in 1986. The study, reviewed and endorsed by the SAB, concluded that selenium levels were not of concern in the study area. The findings were presented to the Members Committee and were subsequently communicated directly to key individuals in the study area by the MDR Principal Investigator in early 1989.

The five-volume report of the MDR study was published and released by the ADRP in 1986, and the medical scientists have since published portions of their findings in several peer-reviewed international medical journals.

In the course of communications planning for the release of the biophysical final report in 1988, Decima Research was commissioned to conduct a public opinion poll of Albertans to determine the most effective methods for releasing the results. Part of this poll included a sub-sample in the Pincher Creek area. This sample determined that more than 75% of residents in that area remain reassured by the results of the MDR, a fact which gave reassurance to the Members Committee as to the success of our previous communications strategies.

IV. OCCUPATIONAL HEALTH FEASIBILITY STUDY

In 1986, Dr. T. Guidotti of the University of Alberta Faculty of Medicine was awarded a contract for $25 000 by the ADRP Members Committee to conduct a thorough review of possible study designs for a major Occupational Health Study of acid deposition effects on workers.

The Occupational Health Program, University of Alberta Faculty of Medicine, evaluated the technical feasibility, practicality and potential usefulness of a major study which would examine the health experience of workers in the gas industry, both sweet and sour, and in the thermal power industry. The study had been proposed in 1984 by a panel of scientific advisors convened by the ADRP to establish program priorities.

This project involved an extensive literature search, interviews with at least 40 persons, visits to several field operations, and extensive correspondence with appropriate agencies. The scientific issues were considered in detail and developed in a paper presented to the Second Symposium and Workshop on Acid Forming Emissions in Alberta (Calgary, 13-15 May 1987).

The optimal study design made efficient use of the data available, needed adequate statistical power (the probability of detecting a difference in the population when it is truly present), and minimized bias (factors that distort the study's conclusions). A three-stage approach was implemented over a period of several years.

1. Stage 1. Pilot studies, collection of baseline data needed to assess change over time, an occupational hygiene survey, interviews with old-timers, and the development of a registry of current and retired workers.

2. Stage 2. Cross-sectional study of illnesses and health status among current workers, a death certificate study of retirees, and the development of a system to monitor occupational exposures in representative plants.

3. Stage 3. Prospective study of workers, comparing both industries and the two branches (sweet and sour) of the gas industry, investigating possible associations by retrospective studies within the main study, and examining persons experiencing knock-downs as a special group with clinical studies.

The study was deemed feasible and was useful to both the gas and the thermal power industries. The study had a high probability of identifying any health differences that existed, both to ensure its usefulness in detecting preventable problems and to be believable if no major problems were identified.

On the basis of the study noted above, the following conclusions emerged:

1. An occupational health study is feasible and would be useful scientifically. The major benefits would be to identify any specific problems in either industry that can be corrected to protect the health of the worker of to provide reassurance to the public and to workers that major occupational health problems are not a serious concern. In either instance, the industry affected will be prepared with the information required to manage the situation.

2. With a methodical, staged approach and adequate preparation, a credible study can be developed that will address most of the major issues while accounting for most of the major sources of bias or uncertainty that usually appear in such studies. Because such a study will be more believable and will provide much more useful information, it is likely to be more cost-effective than one-shot comparative study, particularly one based on existing records alone.

3. The thermal power industry has a particular interest in such a study because estimates of risk associated with energy technologies have been published suggesting that conventional thermal power generation is at a disadvantage compared to alternatives. These studies are largely a product of risk assessment exercises of the nuclear power industry. Without its own data and independent studies, the conventional thermal power industry cannot effectively answer its critics.

4. The sweet gas industry is unlikely to emerge as one involving exceptionally high risk but there are a variety of process chemical exposures, mostly shared with the sour gas industry, that merit further investigation.

5. The sour gas industry, with its obvious hazard of H_2S, also presents the hazard of exposure to a variety of process chemicals that must be accounted for in any rigorous study.

6. Knock-downs resulting from exposure to hydrogen sulphide gas are poorly understood, both for their acute effects and for their long-term implications. They require special study and should not be aggregated with high-level exposures generally or other types of accidents.

The scientists submitted the following recommendations to ADRP in the spring of 1987:

1. Consideration should be given to a staged study, as outlined, to be conducted over an extended period of time. Careful preparation, the collection of preliminary data, the design of monitoring systems, and the conduct of pilot studies to test important assumptions will require sustained commitment but will predictably prove more cost-effective than short-term alternatives in the long run.

2. The estimated cost of each element and each stage of the proposed study were presented. These estimates are based on experience with similar study elements rather than detailed budgeting and were considered to be working projections with considerable uncertainty.

3. A steering committee or oversight panel, consisting of representatives of the principal sectors within ADRP, experienced academic investigators and representatives of unions, companies, and worker groups involved, should supervise and monitor the study as it progresses to ensure that it remains on track, on time, and that critical issues are adequately addressed.

4. A conference on chronic health effects of exposure to H_2S may be useful to identify pertinent studies, stimulate investigation, and consider approaches and methodology. This topic is not well covered in the literature and stands as a major gap.

5. The gas and petroleum industry may wish to review the data base available on the toxicology of process chemicals. Although data almost certainly exist beyond that in the scientific literature, such data are not available to investigators and it is likely that considerable gaps are present.

The Members Committee accepted the report and they recommended that the petroleum industry undertake further research described by Dr. Guidotti as a separate initiative. The study as designed was judged, in the final analysis, as being outside the mandate and Terms of Reference of the ADRP.

This study is currently being evaluated and considered by the petroleum industry.

V. BIOPHYSICAL RESEARCH PROGRAM

A. Background of the Development of the ADRP

The signing of the agreement between the Canadian Petroleum Association and Alberta Environment in late 1984, which brought into being the Acid Deposition Research Program, concluded well over a decade of work in formulating research objectives and planning for the ADRP. In April, 1983 the petroleum industry and provincial government announced their intention to initiate an acid deposition research program. In line with that announcement, the ADRP invited internationally recognized scientists to two-task-oriented workshops in Alberta.

These preliminary workshops, held to establish a workplan for the ADRP, led to the publication in June of 1984 of the publication entitled "Researching Acid Deposition: Workshop Proposals". Both the biophysical and human health research committees voiced their commitment to an inter-disciplinary approach to research. The biophysical researchers held their extensive workshop in October of 1983 followed by the human health research workshop which was held in January 1984. In addition to these scientific workshops, the ADRP also sponsored a communications workshop in April of 1984. Upon the release of the Workshops Proposals Document in June 1984, the ADRP invited comments from the interested public. These comments were solicited in order to factor any public concern into the design of the research program.

The Acid Deposition Research Program was given four objectives by that workshop:

1. To provide a comprehensive understanding of the effects and consequences of acid-forming gases on the environment,

2. To provide a scientific basis for sound, long-term environmental management and regulatory control with respect to acid-forming gases,

3. To disseminate such information among members, to the public and government bodies,

4. To undertake any research deemed appropriate.

After having launched the Program, a fifth objective was added:

5. To encourage and include opportunities for public representations to the ADRP.

The workshop document extensively described the type of program and components which would be required to achieve the objectives of the ADRP.

Critical to the eventual success of the ADRP was the formation of two internationally-recognized groups of scientists into the Biophysical and Human Health Science Advisory Boards. These

scientists independently guided the formulation, execution and completion of the research programs and ensured that the highest level of scientific advice was provided to the Members Committee.

These Science Advisory Boards directed the ADRP to study two principal groups of gaseous pollutant-sulphur oxides (SOx) and nitrogen oxides (NOx). This unique integration of the Biophysical and Human Health scientific research teams and advisory boards, became a distinct feature of the ADRP, one which significantly contributed to its success.

In Alberta, the major sources of sulphur oxides originate from natural gas processing facilities, oil sands plants and coal-fired power plants. These industries form a major role in the provincial economy and are an integral component to future economic development plans. Automobiles and urban centres, by contrast, constitute the major sources of nitrogen dioxide, in Alberta, in concert with other industrial facilities such as electric utilities, chemical industries and pulp and paper plants.

Although Alberta's industrial operators are regulated by legislative standards which are among the most stringent in the world, both the industries and government of Alberta committed to a proactive, scientific approach to possible future acidification problems in the province through the ADRP. It was felt by all participating bodies that the ADRP would foster sound environmental management and regulation in the province and contribute to a national data base dealing with acid deposition.

As part of that process, public involvement with the ADRP was solicited from the earliest date.

Throughout the summer and fall of 1984, public responses to the workshop proposals for research were obtained and compiled by representatives of Alberta Environment. These responses were summarized into a compendium which was transmitted to the research teams and the Science Advisory Board. Detailed acknowledgements were sent to each writer from the co-chairman at that date. Fifteen residents of Alberta wrote to the program and each was sent a response at the initiation of the research program by the Program Manager.

B. The Formation of the Biophysical Research Component

In response to a call for proposals, initiated in the summer of 1984, two major proposals were received. One from an integrated team led by the Kananaskis Centre for Environmental Research (KCER) at the University of Calgary and another received from a private sector consortium of companies. After an exhaustive analysis, and after consultation with the Science Advisory Board, the Kananaskis Centre was awarded the contract for the research in late 1984, formally approved by the Members Committee in early 1985.

The research team led by KCER and made up of five private sector companies in conjunction with the University of Minnesota, the

Lawrence Livermore Laboratory of the University of California and the Alberta Research Council, immediately began to plan for and acquire the equipment and personnel required to carry out this exhaustive study. In addition, the Public Advisory Board and Science Advisory Board were both consulted in order to meet the three primary objectives of the program through public representation, proper dissemination of information from the program and world-class scientific research. The program was designed to continue the Biophysical Research Program until Critical Point One, which was to have been reached within 42 months of initiation period.

On April 26, 1985 the Kananaskis Centre released the document entitled "Criteria and Recommendations for Point Source and Background Location Selection for the Biophysical Aspects of the ADRP." This document established the criteria and characteristics for site selection of the monitoring stations for the ADRP. In addition to being reviewed by the Science Advisory Board, this document was carefully reviewed by all members of the Members Committee. Recommendations were subsequently formulated for the Members as to the sites for the monitoring program. Based on these criteria, and other associated data, monitoring sites were selected at Crossfield (2) and at Fortress Mountain (1).

In early 1985, the Members Committee established contracts for a Program Manager and a Communications Manager for the program. These individuals worked directly with the Co-Chairman and the Members Committee to support the fulfilment of the objectives for the program. In addition, an independent facilitator for the Public Advisory Board was retained in 1987. At that time, the PAB was restructured and expanded through the work of the facilitator and the original PAB Members.

After the extensive media work completed at the conclusion of the MDR research, the communications program began to focus on the Biophysical Component. Numerous interviews with the media were carried out and five annual reports were authored by the program in advance of the release of the final report in September, 1988. Numerous news conferences held in Calgary and Edmonton were set out to announce publication of the world literature reviews and area emission inventories. As the Program proceeded, the newsletter "update" was published regularly to ensure that ADRP's public audience was informed of progress.

The final Biophysical report and other news releases and background material for public information was subsequently prepared and distributed to the ADRP mailing list of 1 500 individuals. These included members of the Alberta Legislature and individuals literally from around the world. In total, as a result of the Biophysical Program of ADRP, sixteen volumes of research reports were printed and registered with the National Library of Canada and in other specialized scientific data bases in North America. All Alberta libraries have been provided with the ADRP overview reports, while full reports have been provided to Canadian university libraries and other specialized environmental libraries.

These reports were provided to the information centres without charge by the Program, as were those sent to more than 500 scientists and members of the public who wrote requesting our research publications.

In addition, an extensive information advertising program was undertaken at the time of the release of the final report and these included direct advertisements in Alberta's news and magazine media. More than 2 000 requests for information on the ADRP were sent to the program office by interested members of the public, and were filled as part of the information program. Numerous speaking engagements, conferences, seminars and workshops were attended, focusing on the question of acid-forming gases.

The Public Advisory Board to the Program issued a preliminary statement in September 1988 which reflected the unanimous views of the membership. The eight representatives on the Board which comprised interests in agriculture, health care and environmental issues, were, at the time of writing of this report, still preparing their final report and recommendations to the Members Committee.

C. The Goals of the Research of the Biophysical Program

Scientists of the biophysical program were trying to answer two basic questions for Albertans:

1. At the present time are there environmental problems with deposition on Alberta's crops, forests, soils, streams and lakes?

2. If not, where and when and under what conditions will such effects occur?

The ADRP set out four components early on as essential to the completion of the goals necessary to attain Critical Point One. The study, which considered many sources of emissions, was to develop a regional-scale assessment of acid deposition effects in Alberta.

1. World Literature Reviews

In November, 1987 the ADRP released an 11 Volume World Literature Review on acid deposition causes and effects. The release of these information packages brought to an end one of the four primary components to the ADRP program.

These 1 300 page review volumes provided the research scientists with a comprehensive understanding of the causes and ecological effects of acidifying pollutants in other parts of the world. The literature reviews also provided initial observations as to how this data base might apply to Alberta.

2. Emission Inventory

A detailed inventory of emissions of sulphur oxides (SOx) and nitrogen oxides (NOx) throughout Alberta, accurately identified as to location, was prepared. This is the most comprehensive inventory in Alberta, and it has been recognized internationally for its design and completeness.

The emission inventory identified 565 individual sources of sulphur dioxides and 4 025 sources of nitrogen oxides. These pollutants are major contributors to acid deposition. Sources include licensed industrial plants and facilities, urban centres, and frequently travelled highways. The report noted that the major source of both SOx and NOx in Alberta is the petroleum industry. Other important sources are electric power plants (NOx and SOx), highways (NOx) and urban centres (NOx).

3. Source Characterization

Next, a comprehensive measurement and description of Alberta's air quality was done through the installation and operation of three sophisticated air monitoring stations. The stations measured the chemical make-up of the atmosphere and meteorological conditions. These measurements involved the study of air pollution in the form of gases, particles and rain, as well as wind speed and direction, temperature, barometric pressure, precipitation, humidity and radiation.

An air monitoring station located at Fortress Mountain obtained data on the quality of air entering Alberta. The scientists refer to this as "background air quality". Two other monitoring stations were located near a source of industrial emission (a gas plant) near Crossfield, Alberta. The "Crossfield West" station sampled air modified by agricultural activities and by the general level of human activity in Alberta. "Crossfield East" station added to this data by measuring pollutants from the City of Calgary, from a major traffic corridor (Highway 2), and from a medium-sized gas plant.

A major finding from the monitoring network was that on more than 280 occasions over a two-year period at Fortress Mountain, high ozone (O_3) concentrations were observed at levels comparable to those experienced in some major cities. The ozone occasions were also considered significant by the scientists as the levels exceeded Alberta's air quality objective with respect to ozone. The Alberta ozone standard for one hour is 80 ppb (parts per billion). Through further study, the scientists concluded that the high ozone concentrations were probably not due to locally produced ozone or due to the downward movement of ozone from the stratosphere. This pollutant, Ozone, was the one compound measured at Fortress Mountain that the scientists were able to

detect at levels greater than those considered within the range of global concentrations.

High hourly O_3 concentrations also occurred at Crossfield during the same period as Fortress Mountain (April-June, 1987). Based on detailed analyses, it appeared probable that on "episode" days, ozone in air masses arriving at Fortress Mountain from outside the Province of Alberta was subsequently carried along the downslope of the mountain, to the Crossfield sites.

In summary, the ADRP air quality monitoring network constituted one of the most technically sophisticated air measurement systems in the world during the 26 months of its operation. It achieved all the objectives which were set for it and obtained many other findings which were unforeseen in the initial stages of the program.

4. Modelling and Creation of Scenarios

Through the use of sophisticated predictive computer models, the final stage of the research program was to simulate the possibility of any regional-scale environmental effects on Alberta's crops, soils and surface waters from the known sources of acid deposition. These simulations required access to all the above-noted sources of data and constituted among the most complex, sophisticated scientific modelling of acid deposition attempted in North America. Teams of scientists validated, checked and judged the output from the simulations, in concert with the Science Advisory Board who carefully reviewed and approved each step in the process.

The result of this intensive effort was to have identified the sensitive geographic areas, corps, soils and water bodies within Alberta which may be subject to regional acidification effects. A key factor was that the approach taken by the scientists was exceedingly conservative. The scientists were of the opinion that it was important to employ models which were more likely to point to effects where there may have been none rather than to fail to predict an effect which was actually occurring. Hence, the program is confident that the scientific output represents a valid "early warning" system which clearly points to areas which may be subject to the early effects from acidification.

D. The Findings of the Biophysical Research Program

The scientists concluded that it is unlikely there are regional scale impacts of acid deposition in Alberta today. They have, however, cautioned that intensive industrialization will increase the risks associated with pollution in several areas identified as sensitive.

In their final report, the scientists said:

"Regional scale impacts of acid deposition on crops, soil and surface waters today are not demonstrated and likely absent, with a slight reservation in the area of possible small impacts on alfalfa growth in a few areas. Large increases in average deposition levels, however, could impact alfalfa an similarly susceptible vegetation in areas that also experience high concentrations of ozone, and increased deposition of acidic and acidifying pollutants could acidify soils and surface waters in a few susceptible areas."

The area identified by the scientists to have possible small alfalfa impacts is northwest of Edmonton. The scientists used actual alfalfa yield data for several locations in Alberta, including Cold Lake, Crossfield and Barrhead. In the Barrhead area only, when the actual yield data was compared, with the use of models, to yield estimates, the yield was lower than expected. Verification of the model's predictions in the field is recommended.

Impact on wheat growth was also examined for Alberta, but no negative effects were indicated. A number of soil types in forest areas and certain lakes in heavily forested areas were determined to be sensitive to increased pollution.

The scientists determined that the concentrations of acid-forming pollutants in Alberta, even in regions influenced by highways, cities and industrial plants, are extremely low. Dr. Sagar Krupa, Chairman of the SAB stated that:

> "Whether you make comparisons with the pristine conditions at Fortress Mountain or to one of the world's most polluted areas, acid pollutants in Alberta's air are at low concentrations. These findings, however, should not be interpreted to say that there are no environmental concerns in Alberta. There are some sensitive areas that could be affected if the pollution levels, or the mix of pollutants, increase dramatically.
>
> One of the scientific findings, which was a complete surprise, relates to this caution. On a number of occasions, the scientific team detected the long-range transport of ozone into Alberta from British Columbia and the State of Washington. This is the first time that the long-range transport of ozone has been observed in Western Canada."

In summary, the three-year $5.3 million study was rated as one of the most comprehensive studies of air pollution in the world. That rating came from the independent Science Advisory Board (SAB) composed of air pollution specialists credibility. In its final report to the ADRP Members Committee, the SAB said that the air monitoring work conducted as part of this study at Fortress Mountain "will serve as a benchmark for the rest of Canada and the United States... The results of the monitoring exercises have generated a data base of air quality unmatched elsewhere in the world."

One of the mandates of the scientific team and the Science Advisory Board was to make recommendations to the ADRP on what types of future research would be most productive, adding to the body of knowledge we now have. Dr. S. Krupa, Chairman of the SAB noted that: "The major recommendations for future scientific work is to focus on the areas identified as sensitive in Alberta. Now we have a narrower field to deal with and we can focus on the sensitive areas, verify the findings of work to date, and consider the effects of combinations of pollutants".

In undertaking the ADRP, funders committed to establishing a scientific base of knowledge which would help Albertans determine the policies for sound, long-term environmental management and regulatory control. The Acid Deposition Research Program achieved this objective.

The recommendations of the scientists of our SAB and the policy recommendation of the Public Advisory Board have been considered and communicated to senior decision makers. The successful completion of the objectives set out in 1984 for the attainment of Critical Point One of the Acid Deposition Research Program marks a major turning-point for regulators, decision-makers and scientists involved in acidic deposition in Alberta across Canada and throughout the international scientific community.

The Members Committee acknowledges receipt of the recommendations and conclusions of the Public Advisory Board and the Biophysical Research team.

Those specific recommendations have been communicated to the funding agencies of the Acid Deposition Research Program and to the Alberta Ministers of Environment and Community and Occupational Health.

The Public Advisory Board and Science Advisory Board have been notified in writing of this transmittal of their views, and all these conclusions and recommendations have been published.

To ensure Albertans have access to sound environmental management data, the Members Committee concludes that:

- Mechanisms to fund and support a scientific baseline air quality monitoring have been referred to the Minister of Alberta Environment to explore this issue between the appropriate federal and provincial agencies.

- Alberta Environment should evaluate the need to undertake specific research to ensure the protection of sensitive environments identified by the ADRP program. This conclusion, along with the specific recommendations of the PAB and SAB, have been referred to the Minister of Alberta Environment.

- The Members Committee recognized the comprehensive evaluation of the Medical Diagnostic Review (MDR) study carried out by

the Science Advisory Board in 1986. That Board recommended as follows:

"3. We also concur with the third recommendation of the Report concerning the inadvisability of new data collection concerning the health status of residents in the Index Area. The very comprehensive studies incorporated in the MDR should be regarded as the definitive examination of the health of residents in the region. However, the results of the MDR do not exclude the possible need for future studies of health effects of specific industrial pollutants in Alberta.

4. In order to determine if the naturally occurring low selenium levels in the Index Area (IA) might have any implications in terms of human health, limited additional analyses of data already available in the MDR should be carried out. It should be determined whether subjects with undetectable hair levels of selenium show an excess of adverse health effects which might be ascribable to a low selenium status. If this is found, additional studies of this specific question may be indicated." (SAB Final Review, 1986, pg. 30.)

This special study on selenium effects concluded that there were no adverse health effects which can be ascribed to either a high or low hair selenium level in the Index Area (IA). These results were presented to the Community Advisory Board at Pincher Creek on March 3, 1989. The completion of this last component fulfils the administrative mandate of the Members Committee for the completion of the Medical Diagnostic Review.

- The results of the Occupational Health Feasibility Study have been communicated to the Department of Community and Occupational Health and to the Health Sub-Committee of the Canadian Petroleum Association.

- While outside the strict Terms of Reference for ADRP, the Members Committee recognizes that there is a need to conduct detailed veterinary health studies in the province, particularly in specific areas of acidic emissions. The Members Committee recognizes the need to follow up on this veterinary health research program, and accordingly has transmitted the recommendation to the Alberta Environment Centre at Vegreville, Alberta.

The ADRP was a unique Canadian research initiative which used a consultative approach between the Petroleum Industry, Government and general public to problem-solving in a complex, and highly technical, field. The success of this model should be considered for future major research initiatives in Alberta and Canada. The valuable input from the public-at-interest to research scientists and the subsequent communications on technical, scientific findings back to the public became a hallmark of the ADRP. The Members Committee, having fulfilled its mandate to the ADRP, concludes that

Critical Point 1 has been successfully attained and the work of the Members Committee has been completed.

APPENDIX I

ACID DEPOSITION RESEARCH PROGRAM ORGANIZATION

APPENDIX I

ACID DEPOSITION RESEARCH PROGRAM ORGANIZATION

A. ADRP MEMBERS COMMITTEE

Ken R. Smith (Co-Chairman)
Assistant Deputy Minister
Alberta Environment

Ron L. Findlay (Co-Chairman)
Manager, Environmental Affairs and Safety
Amoco Canada Petroleum Company Ltd.
Canadian Petroleum Association

Ed. R. Brushett
Manager, Environment Protection
Energy Resources Conservation Board

Dr. John Railton
Special Projects Manager
Monenco Consultants Limited
Utilities Group Representative

Carl L. Primus
Environmental Health
Alberta Community & Occupational Health

Douglas Bruchet (Treasurer)
Manager, Environmental and Socio-Economic
Development
Canadian Petroleum Association

Dr. Cornelius (Casey) G. Van Teeling
(Secretary)
Alberta Environment

Dr. H. Percy Sims (Special Advisor)
Alberta Environment

Dr. Harby S. Sandhu (Special Advisor)
Alberta Environment

Susie Washington
Moderator Public Advisory Board

Dr. Ron Wallace
Program Manager

B. COMMUNICATIONS COMMITTEE

Mr. Ed Brushett, Committee Chairman
Energy Research Conservation Board

Douglas Bruchet
Canadian Petroleum Association

Jean L. Andryiszyn
Communications Co-ordinator

Susie Washington, Moderator
Public Advisory Board

Dr. Ron R. Wallace
Program Manager

C. BIOPHYSICAL TECHNICAL RESEARCH ADVISORY COMMITTEE

Dr. John Railton, Chairman
Monenco Consultants Limited
(Utilities Group Representative)

Randy Angle
Alberta Environment

Earle Baddaloo
Alberta Environment

Lin Callow
Gulf Canada Resources

David McCoy
Canterra Energy Ltd.

D. TECHNICAL RESEARCH ADVISORY COMMITTEE - HUMAN HEALTH

Dr. Linton Kulak, Chairman
Shell Canada Limited

Dr. Graham Gibbs
Alberta Community and Occupational Health

Ed A. Collom
Alberta Community and Occupational Health

Dr. Dennis Stokes
Alberta Environment

E. SCIENTIFIC ADVISORY BOARD - BIOPHYSICAL RESEARCH

Dr. Sagar V. Krupa, Chairman SAB
University of Minnesota
(Department of Plant Pathology)

Dr. C. M. Bhumralkar
National Oceanographic and
Atmospheric Administration (NOAA)

Dr. Herbert C. Jones
Tennessee Valley Authority
Fisheries and Aquatic Ecology Branch

Dr. Ron Kickert
Consultant (in modelling)

Dr. H. M. Liljestrand
University of Texas
(Department of Civil Engineering)

Dr. James P. Lodge
Consultant in Atmospheric Chemistry
and Editor, Atmospheric Environment

Dr. Douglas P. Ormrod
University of Guelph
Department of Horticultural Science

Dr. Carl L. Schofield
Cornell University
(Department of Natural Resources)

Dr. Robert K. Stevens
U.S. Environmental Protection Agency

Dr. M. Ali Tabatabai
Iowa State University
(Department of Agronomy)

Dr. T. Craig Weidensaul
Ohio Agricultural Research and
Development Center
Ohio State University

F. SCIENTIFIC ADVISORY BOARD - HUMAN HEALTH RESEARCH

Dr. Benjamin Burrows, M.D.
Chairman SAB
Professor of Internal Medicine
Director, Division of Respiratory Sciences
University of Arizona

Dr. Zoltan Annau
Professor
Department of Environmental Health Services
The John Hopkins University
School of Hygiene and Public Health

Dr. Gerry Hill, M.D.
Director
Human Nutrition Research Center
Agriculture Research Center
U.S. Department of Agriculture

Dr. Walter Mertz, M.D.
Director
Human Nutrition Research Center
Agriculture Research Center
U.S. Department of Agriculture

Dr. Jonathan M. Samet, M.D.
Associate Professor of Medicine
Department of Medicine
University of New Mexico

Dr. Mark J. Utell, M.D.
Associate Professor of Medicine and Toxicology
Co-Director
Pulmonary and Critical Care Unit
University of Rochester School of Medicine

G. MEMBERS - PUBLIC ADVISORY BOARD

Moderator, Susie Washington

Dr. Nicholas Bayliss
Alberta Health Care Associations

Herman Bulten
Christian Farmers Federation and
Other Agricultural Associations

Hank Gauthier
Energy and Chemical Workers Union

Dennis Gogal
Environmental and Outdoor Education Council,
Alberta Teacher's Association

Dr. Lochan Bakshi
Public Advisory Committee, Athabasca University
Environment Council of Alberta

Sam Sinclair
Alberta Aboriginal Peoples

Dr. Dixon Thompson
University of Calgary
Science Advisory Committee
Environment Council of Alberta and
Alberta Society of Professional Biologists and
Canadian Society of Environmental Biologists

Prof. Eric Tollefson
University of Calgary
Association of Professional Engineers,
Geologists and Geophysicists of Alberta

H. PROGRAM MANAGEMENT

Jean Andryiszyn
Communications Co-ordinator

Dr. Ron R. Wallace
Program Manager

I. THE SCIENTIFIC STUDY TEAM

The biophysical research contract was awarded in January, 1985 to a university-private sector team headed by the Kananaskis Centre of Environmental Research of the University of Calgary. The research contract involved more than 20 professional scientists plus technical support personnel. Besides the resources of the Kananaskis Centre, the scientific expertise of individuals from the following organizations and companies was retained to assist the ADRP:

- ASL and Associates, Helena Montana
- Alberta Research Council, Terrain Science Department, Edmonton, Alberta
- Aquatic Resource Management Ltd., Calgary, Alberta
- Carnegie Mellon University, Department of Civil Engineering, Pittsburgh, Pennsylvania
- Dominion Ecological Consulting, Ltd., Calgary, Alberta
- Lasat Geobotanical Surveys Inc., North Vancouver, BC
- Element Analysis Corporation, Tallahassee, Florida
- Emporia State University, Department of Biology, Emporia, Kansas
- Florida State University, Department of Oceanography, Tallahassee, Florida
- Illinois State Water Survey, University of Illinois, Champaign, Illinois
- Lawrence Livermore National Laboratory, Environmental Sciences Division, Livermore, California
- McVehil-Monnett Associates, Englewood, Colorado
- Nuclear Element Analysis (NEA), Inc., Beaverton, Oregon
- Subsurface Technologies, Ltd., Calgary, Alberta
- The University of Calgary, Department of Biology, Department of Geography, Department of Mathematics and Statistics, Department of Physics
- U.S. Department of Agriculture, Beltsville, Maryland
- Western Research, Calgary, Alberta

APPENDIX II

REPORT ON CRITICAL POINT ONE

PUBLIC ADVISORY BOARD

REPORT ON CRITICAL POINT ONE OF THE

ACID DEPOSITION RESEARCH PROGRAM

APRIL, 1989

PUBLIC ADVISORY BOARD

REPORT ON CRITICAL POINT ONE OF THE

ACID DEPOSITION RESEARCH PROGRAM

FOREWORD

Critical Point One of the Acid Deposition Research Program (ADRP) has been reached. As mandated by ADRP, the Public Advisory Board (PAB) has discussed the Medical Diagnostic Review and the Biophysical Research. This report represents the initial conclusions and recommendations of the PAB with respect to the extremely complex and sensitive environmental issues raised by both research initiatives.

SUMMARY OF RECOMMENDATIONS

The Public Advisory Board of the Acid Deposition Research Program has made recommendations in three areas: Science, Policy and Legislation and Social Issues. The key recommendations are as follows:

Science

1. There is a need for Alberta Environment to establish a long-term air quality monitoring program for the entire province. The program needs to include stations that monitor air entering the province, stations that monitor air quality leaving the province, and stations for identified sensitive areas--including those in the northern part of the province.

2. There is a need for Alberta Environment and Environment Canada to re-establish the baseline monitoring station at Fortress Mountain.

3. There is a need for Alberta Agriculture to conduct veterinary medical health studies as recommended by the Veterinary Medical Health Workshop. There is also a need for Alberta Agriculture, in concert with Alberta Environment, to validate models of alfalfa growth as recommended by the ADRP's Science Advisory Board of the Biophysical Research Program.

4. There is a need for Alberta Technology, Research and Telecommunications to work with the scientists of ADRP and industry to review the air quality monitoring methods as used in ADRP to discover possible pollution control technologies that can be developed for commercial purposes.

Policy and Legislation

1. There is a critical need for the Government of Alberta to work with industry to develop an incentive program to enable the phasing out of older industrial facilities or the retrofitting of these plants with updated pollution control technology.

2. There is a need for the Government of Alberta and industry to establish an environmental clean-up fund.

3. There is an immediate need for the Government of Alberta to develop the legislative amendments as recommended by the Task Force on Environmental Enforcement, to make the Clean Air Act enforceable.

4. There is a need for the Government of Alberta to co-ordinate efforts that include industry and the public, working toward the concept of a "clean-air bubble" for the province--<u>before</u> there are air quality problems.

Social Issues

1. Complex environmental problems demand an educated public. Alberta Education must include environmental education as part of the primary and secondary school core curriculum to meet this challenge.

2. Finally, and as explicitly noted in many of the detailed recommendations which follow, there is an on-going need for additional consultative approaches to problem-solving for environmental protection. If we are to solve the problems for today and for the future, government as well as industry and non-government organizations must participate in the planning, design and implementation of new legislation and new systems of administration. As well as being more effective, this approach is also cost effective in terms of both time and money.

Specific multi-sectoral discussions are recommended for many of the proposed recommendations, including:

a. Northern Alberta research program;

b. Veterinary Medical Health program;

c. Industry Environmental Protection Incentive program; and

d. New Approaches to the Management of Alberta's air quality.

INTRODUCTION

The Public Advisory Board (PAB) commends the work of the Acid Deposition Research Program (ADRP) and endorses the recommendations of the Biophysical Research Scientific Advisory Board (SAB). The results of the study are good news in the sense that Albertans have time to act to prevent the development of serious pollution problems that currently face many other regions of Canada and the world. Moreover, the baseline data developed from the methods employed by the biophysical research team is a significant first step toward establishing new standards of study.

Albertans have a reason to be proud of the research but we cannot afford to become complacent. Although Alberta may have relatively clean air at the present time, we must be vigilant for the future. We also cannot afford to look at Alberta in isolation from the rest of our planet. If we are to meet the challenge of managing acid gas emissions and the challenge of sustainable development, as recommended by the National Task force on Environment and Economy, there must be a sense of purpose and strong leadership.

In order to create the new institutional arrangements necessary to ensuring effective management of our environment and economy. In other words, having spent the funds on the research done to date, follow-up mechanisms must be put in place to ensure that the excellent work of ADRP does not sit on a shelf.

Thus, notwithstanding the importance of the findings of the Biophysical Study, PAB has not limited its discussion to the scientific issues resulting from the study. Rather, PAB has also focused on policy, legislative and social issues arising from the Biophysical Study. In general, we believe the decisions now facing the ADRP Members Committee are no longer the scientific measurement questions of "how to" or "how much". Rather the questions now facing the ADRP Members Committee, and the sectors represented, are the questions of goals, priorities and consequences. Moreover, there is a need to address what new policy and legislation needs to be put in place to meet the challenge of these goals and priorities.

The recommendations for change set out in the Report on Critical Point One are not necessarily new suggestions. They represent a consolidation of existing trends in research, policy development and practice and build upon the findings of the biophysical research. They also build on the mandate for action suggested by The National Task Force on Environment and Economy and the successful models of multi-sectoral (round table) discussions used by the ADRP Public Advisory Board and the Alberta Task Force on Enforcement. The expanded and re-organized Public Advisory Board has allowed for an interactive consultative process and, more importantly, one that has helped the ADRP Members Committee to produce better decisions. It is a proven, successful model for the future and should be used again. Success has been measured by the extent to which balance has been achieved between the various interests and consensus reached on steps for action.

The following are specific suggestions and conclusions.

Scientific Issues

1. EXISTING RESEARCH: Perhaps the most startling aspect of the Biophysical Research is that periodic high ozone levels were reported at both the Fortress and Crossfield monitoring sites. This new piece of the air quality puzzle may have some indirect impact on the findings of the Medical Diagnostic Review (MDR). Although there is no conclusive evidence, one can pose the hypothesis that there may be a linkage between health effects and the concentrations of ozone observed in Alberta.

   As well, the biophysical research demonstrates that there is measurable difference in air quality between the Crossfield West and Crossfield East monitoring sites. In other words, it can be concluded that although the Crossfield East one-hour mean concentrations of gases measured (SO_2, NO, NOx) are far below existing standards, the combination of industry, transportation systems and urban areas appears to be adversely affecting air quality. On the other hand, hydrogen sulphide (H_2S), at least at this monitoring station, does not seem to be increasing. Given these data, the Public Advisory Board recommends implementing a long-term, province-wide air quality monitoring program. This program will assist in the development of control strategies to maintain the existing levels of air quality.

   With respect to the summary report on the biophysical research, the PAB is concerned about the potential for confusion regarding the methodologies used for measurement of pollutants at Fortress Mountain, Crossfield West and Crossfield East, the presentation of the data, and interpretation of the results. The report should have clearly stated that there was not need for cryogenic testing at the Crossfield East site because levels of pollutants were high enough that they could be adequately measured by conventional means. The report also did not clearly state that the cryogenic concentration technique was used in an effort to complete the data set because Fortress Mountain and Crossfield West were so clean and pollutants were "below detection limits".

   As well, the presentation of the results from these sites makes interpretation difficult. Figures 9 and 10 in the Summary Report should have used the same scales and the same colour codes to illustrate sulphur dioxide (SO_2). As presented, most readers will misinterpret the data, failing to notice that the colour codes are not the same (red at Crossfield West is about 0.5 ppb but is about 1.1 ppb on the Crossfield East data, the intermediate yellow is above 8 ppb for the Crossfield West data but above 32 ppb for the Crossfield East data). If the research report is to be reprinted, the PAB recommends revising the colour codes in a consistent manner.

2. FURTHER RESEARCH: The Public Advisory Board strongly supports the SAB recommendations that background monitoring in the province be established:

   a. At a minimum, the work at Fortress Mountain should be resumed, on a continuing basis. This would not only provide background measurement, but would also monitor the quality of air entering Alberta. PAB is aware that monitoring stations of this complexity are expensive and also recognizes that Environment Canada has a mandate for Long Range Transport of Air Pollutants. Given that ADRP has demonstrated transboundary movement of air pollutants in Western Canada for the first time, the Public Advisory Board urges Alberta Environment and Environment Canada to consider establishing a regional background air quality monitoring station at Fortress. A joint initiative of this kind would serve as a model of intergovernmental co-operation. It would also respond to what the Bruntland Commission and others call "managing the commons". In other words, sustainable development for the common public interest can be secured only through national and international co-operation.

   b. Another area for further research which was explicitly recognized by the scientists on the Biophysical Scientific Advisory Board has surfaced as a result of ADRP's limited scope. Specifically, the ADRP study area was restricted to the southern part of the province and thus, there was no predictive or integrative monitoring or modelling done in the northern part of the province.

      The Public Advisory Board recommends that such research be undertaken particularly in view of the fact that proven methods and study design already have been established through ADRP. The financial means now need to be found to develop a predictive baseline for northern areas in the province identified by ADRP as sensitive. This is particularly significant because of projected oil sands developments around Fort McMurray and because of the projected increases in pulp mill operations in the north-central part of the province.

      Although there may be a need for more or different funding participants (e.g., the forest industry as well as the oil and gas developers in the region), experience with the ADRP suggests that joint sponsorship is a viable concept. By the same token, a public body similar to PAB should be established to involve interested parties such as northern native peoples. It is important that northern native peoples have an opportunity to air their concerns on environmental matters in such a body.

   c. As well, the PAB wishes to highlight the SAB recommendation that there is an immediate need for appropriate research to construct and validate models of alfalfa growth under specific soils, climatological and pollutant exposure conditions in

Alberta. This could be achieved through a joint initiative between Alberta Agriculture and Alberta Environment.

d. Finally, (and as has been stated previously in the Existing Research section of this document) there is an immediate need to develop a system for on-going air quality monitoring for the whole province. This provincial monitoring plan should include stations that monitor air coming into the province (e.g., the Fortress monitoring station) as well as stations that monitor the quality of air leaving the province, and in identified sensitive areas. We must allow complacency, which may result from the findings of the ADRP, to override the need for such action.

3. NEW TECHNOLOGY: Alberta has achieved a leadership role in managing a successful and integrated environmental research program and in developing air pollution monitoring technology. Both the management approach and technology have significant commercial application in Canada and in the international marketplace. The Public Advisory Board recommends that:

a. The Government of Alberta and the Canadian Petroleum Association ask the ADRP biophysical research scientists and SAB to conduct a review of current air quality monitoring methods to discover if there are possibilities for exploitable technology related to monitoring and control. If there are commercial opportunities, this is the type of project the Alberta Energy and Alberta Department of Technology Research and Telecommunications and Alberta Economic Development and Trade could encourage. The development of Alberta pollution control technologies for international markets would not only benefit local resource development industries but could open up new areas of environmental business. Indeed, some of the spin-off benefits from an expensive research program, such as ADRP, are the economic development and employment opportunities. These should not be ignored.

b. Joint industry-government initiatives need to be established to finance business contributing to environmental improvements such as monitoring and control technology; and

c. The sponsors of ADRP should promote the ADRP model as an effective management-support strategy for Research and Development. It is a unique concept and one that brings the strengths of industry, government agencies, universities and the public to the table in an integrated manner.

4. VETERINARY MEDICAL HEALTH: For some time, the Public Advisory Board has had concerns with respect to possible acid gas emission effects on animal health. Indeed, because of these concerns, the issue of animal health was referred to Alberta Agriculture. To date, there has been some work done by scientists at the Vegreville Research Centre and they have recommended additional work be conducted. However, Alberta Agriculture has not effectively responded to the recommendations from the Veterinary Health

Workshop and to the needs of the Alberta agricultural community in this area. Work parallel to that of ADRP and MDR needs to be done. The PAB recommends the following:

a. That Alberta Agriculture establish a Public Advisory Board, made up of appropriate agricultural interest groups;

b. That with the input of this multi-stakeholder body, Alberta Agriculture should develop a study to satisfy the long standing question farmers have had regarding animal health; and

c. That a Science Advisory Board be established in order to enhance study design and, ultimately, the credibility of research results.

The Role of Policy and Legislation

The results of the ADRP explicitly state that there are likely to be risks associated with pollution in parts of the province if there is greater industrialization and/or increase in population--both of which are virtually certain to occur.

The Public Advisory Board urges the Alberta Government to cast its net wider than previously envisioned, using new policy and legislative approaches to ensure that we do meet the challenge of managing our air quality within the framework of sustainable development. Given ADRP results, and as a first step, PAB recommends that the existing criteria be reviewed and updated to establish what is clean air and what are acceptable standards. In the same vein, a fresh approach to pollution control is needed. We cannot afford to keep licensing pollution until we see negative effects. By the time negative effects are measurable, the damage has already been done.

1. The Public Advisory Board recognizes that the new Sulphur Guidelines are an important step toward controlling emissions, but they are not enough. If economic growth continues, we must--in order to maintain our existing air quality--continually reduce the net amount of pollution or other environmental degradation per unit of output. This requires cleaner and better modes of production and consumption and incentives. The PAB recommends that:

   a. The task before government is to work with industry to develop an incentive program for industry to phase out older plants and replace them with new plants with updated pollution control technology. As well, efforts to reduce emissions by increasing combustion efficiency wherever possible, could be encouraged by an incentive program, whether through research or by improvements in practice.

   b. The province of Alberta establish an environmental clean-up fund. Initially, the fund could be financed by a modest one-time levy on corporate profits, or by an individual surtax

on effluent levels or on production. The funds would be used to clean-up environmental disasters or long-term environmental pollution problems. In the future, the cost could be charged back to individual companies who pollute, representing a liability in financial statements. Companies who do not pollute would not be charged. Thus, good corporate citizenship is encouraged and the onus of responsibility (in keeping with the province's position) is that the "polluter must pay".

Against this background, the Public Advisory Board recommends that the discussions for such incentive programs be developed by building on a multi-sectoral body, such as the PAB or the Task Force on Enforcement, to determine the specific financial and investment vehicles necessary for an environmentally sound future.

2. Incentives alone are not enough, however. There also needs to be the means to enforce the law for those companies who do not comply with the Clean Air Act and stiff penalties for offenders. While the Public Advisory Board commends the efforts of Alberta Environment on implementing many of the department specific recommendations from the Task Force on Enforcement, many of the important recommendations have yet to be fully addressed. The Public Advisory Board strongly concurs with the view of the Task Force that there is a high priority for the Government of Alberta to develop legislative amendments to make the Clean Air Act enforceable.

3. Perhaps most important, ADRP has given us a benchmark on background air quality in Alberta. It is one, given the conservatism of the models used, that suggests "it is extremely unlike that, except in the immediate vicinity of point sources, there is any impact on any ... environmental components." (Page 73, Summary Report of the Biophysical Research). On the other hand, scientists from around the world caution that global warming is occurring and it is part due to the burning of fossil fuels. Therefore, the long-term policy and legislation challenge is to not only articulate clean air standards for Alberta and establish long range objectives for clean air, but begin discussion to create a "clean air bubble" before there is a problem. A legislative mechanism needs to be found that limits the total amount of emissions for an area, or limits industrial expansion unless there is a means to maintain total emission levels.

This "clean air bubble" concept would allow industry to meet pollution obligations in a more cost effective pattern--provided that total emissions do not increase. As well, a logical next step could be to develop the means to allow industrial development to "trade" pollution rights in a type of air quality common market. This is particularly relevant for urban areas such as Edmonton or Calgary. The tradeable permit alternative could tap a great many (and possibly cheaper) ways of reducing emissions, allow for continued and managed industrial expansion, and encourage advancement of pollution control technologies.

The PAB recognizes this approach is a new concept for Alberta. The mechanisms and details need to be discussed at length. Thus, the PAB recommends utilizing the Alberta model of a multi-sectoral body as a means of ensuring broadly based input for this new approach and identifying mechanisms to manage Alberta's overall air quality.

Finally, the development of a "clean air bubble" would not eliminate concerns over plant emission control systems and, accordingly, enforceable laws would remain necessary. As well, an incentive program, such as the ones discussed earlier to encourage pollution control, is needed as part of the package. A "clean air bubble" could, however, build on a market-based incentive system to maximize the complementary, long-run, objectives of environment and economy.

Social Issues

To meet the long-term challenges of better integrating environment and economy as suggested by the Task Force on Environment and Economy, all government departments must accept responsibility for environmental protection in the development of policies and decision-making. Moreover, it will take an educated public to understand the increasingly complex and second generation environmental issues (i.e., global warming, ozone, acid rain, loss of species), to make informed choices, and to be supportive of the policy and institutional changes that will necessarily result. To quote the Bruntland Commission: "Human resource development is a crucial requirement not only to build up technical knowledge, but also to create new values to help individuals and nations to cope with the rapidly changing ... environmental realities." (Page 11, Our Common Future).

While education may not be part of the ADRP mandate, the Public Advisory Board cannot ignore the environmental education problems which stem from existing institutional gaps and compartmentalized responsibilities. We therefore recommend that Alberta Education establish environmental education as part of the primary and secondary school core curriculum. It is not enough to rely solely on the programs of Alberta Environment to provide environmental education to Alberta's children.

CONCLUSIONS

Over the course of the past two years, and through its work, the Public Advisory Board has been able to develop a productive exchange. It has attempted to combine scientific realities with a reasonably broad vision of the public interest, combined with a recognition of the political realities. This report is a consensus document and it represents the opinion from a range of individuals from groups and associations interested in acid deposition in Alberta.

In conclusion, the Public Advisory Board wants to emphasize that clearly the program broke new ground in several areas. First, the biophysical program was timely, a world class study, and the first integrated air quality program. It is a model that needs to be pursued in other jurisdictions and continued in Alberta.

ADRP also made a commitment to transfer scientific information to the general public for their information. It became clear after the Medical Diagnostic Review was completed that it was impossible for ADRP to get detailed scientific information to the public by relying on the media, which is not designed as a vehicle for such information. Thus, for the biophysical program, a large number of interested groups and individuals had access to the findings as a result of the efforts of the ADRP advertising program conducted in the provincial print media. This was the first for a research program and has proven to be successful. The advertising campaign and numbers of people reached should be documented and shared with other research programs around the world. It is important that the research findings of the ADRP also be published in reputable, refereed journals.

Finally, ADRP itself broke new ground in that it provided the first working model of a research program in which lay people had input and provided advice over the course of the study. This is a long way from traditional public participation where the public is asked to react to a policy or program after the fact. We hope this type of research model will be continued in Alberta as well as in other parts of Canada.

Critical Point One of the Acid Deposition Research Program has been passed. This document recommends that public review and input to the next steps, as detailed in this report, begin.

GLOSSARY

Bruntland Commission: The World Commission on Environment and Development (Chaired by Mme. Gro Bruntland) was an initiative sponsored by the United Nations. The Commission developed the report, Our Common Future, 1987. The report called for a global agenda for change with respect to environmental strategies for achieving sustainable development by the year 2000 and beyond.

National Task Force on Environment and Economy: Canada, as an international leader, convened a national task force to consider the findings of the World Commission on Environment and Development. The Task Force on Environment and Economy produced a report that made recommendations to foster and promote environmentally sound economic development in Canada. Their report was submitted to the Canadian Council of Resource and Environment Ministers (CCREM), September, 1987. The Task Force was convened at the request of CCREM and included a range of senior industry leaders, ministers, academics and individuals representing environmental groups.

Task Force on Environmental Law Enforcement: The Task Force was convened at the request of the Alberta Minister of Environment and included a range of environmental and legal experts from Alberta. The Task Force developed an Action Plan for Environmental Law Enforcement in Alberta. It was submitted in January, 1988.